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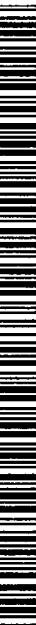
(72) Inventors; and

(75) Inventors/Applicants (for US only): RUDNIC, Edward, M. [US/US]; 15103 Gravenstein Way, No. Potomac, MD 20878 (US). ISBISTER, James, D. [US/US]; 9521 Accord Drive, Potomac, MD 20854 (US). TREACY, Donald, J. [US/US]; 1907 White Heron Road, Annapolis, MD 21401 (US). WASSINK, Sandra, E. [US/US]; 5103 Reels Mill Road, Frederick, MD 21704 (US).

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(54) Title: DELAYED RELEASE ANTI-FUNGAL PRODUCT, USE AND FORMULATION THEREOF

(57) Abstract: An anti-fungal product is comprised of at least three delayed release dosages forms, each of which has a different release profile, with the  $C_{max}$  for the anti-fungal product being reached in less than about twelve hours after initial release of anti-fungal from the product.

**DELAYED RELEASE ANTI-FUNGAL PRODUCT, USE AND  
FORMULATION THEREOF**

This invention relates to an anti-fungal product, as well as the use and formulation thereof.

A wide variety of anti-fungals have been used, and will be used, in order to combat bacterial infection. In general, such anti-fungals can be administered by a repeated dosing of immediate release dosage forms, which results in poor compliance or as a controlled release formulation (slow release) at higher administered doses. The present invention is directed to providing for an improved anti-fungal product.

In accordance with one aspect of the present invention, there is provided an anti-fungal pharmaceutical product which is comprised of at least two, preferably at least three, anti-fungal dosage forms. Such dosage forms are formulated so that each of the dosage forms has a different release profile.

In a particularly preferred embodiment, there are at least two, preferably at least three dosage forms, each of which has a different release profile and the release profile of each of the dosage forms is such that the dosage forms each start release of the anti-fungal contained therein at different times after administration of the anti-fungal product.

Thus, in accordance with an aspect of the present invention, there is provided a single or unitary anti-fungal product that has contained therein at least two, preferably at least three anti-fungal dosage forms, each of which has a different release profile, whereby the anti-fungal contained in each of such dosage forms is released at different times.

In accordance with a further aspect of the invention, the anti-fungal product may be comprised of at least four different dosage forms, each of which starts to release the anti-fungal contained therein at different times after administration of the anti-fungal product.

The anti-fungal product generally does not include more than five dosage forms with different release times.

In accordance with a preferred embodiment, the anti-fungal product has an overall release profile such that when administered the maximum serum concentration of the total anti-fungal released from the product is reached in less than twelve hours, preferably in less than eleven hours in each case after initial release of the anti-fungal. In an embodiment, the maximum serum concentration of the total anti-fungal released from the anti-fungal product is achieved no earlier than four hours after initial release of the anti-fungal.

In accordance with one preferred embodiment of the invention, there are at least three dosage forms, each of which is a delayed release dosage form (which may be a pH sensitive or a non-pH sensitive delayed dosage form, depending on the type of anti-fungal product). More particularly, the anti-fungal release from the second of the at least three dosage forms achieves a  $C_{max}$  (maximum serum concentration in the serum) at a time after the anti-fungal released from the first of the at least three dosage forms achieves a  $C_{max}$  in the serum, and the anti-fungal released from the third dosage form achieves a  $C_{max}$  in the serum after the  $C_{max}$  of anti-fungal released from the second dosage form. As used

herein first, second, third, etc., refers to the order in which anti-fungal is released from the dosage form.

In one embodiment, the second of the at least two dosage forms initiates release of the anti-fungal contained therein at least one hour after the first dosage form initiates release, with the initiation of the release therefrom generally occurring no more than six hours after initiation of release of anti-fungal from the first dosage form of the at least three dosage forms.

In general, the first dosage form produces a  $C_{max}$  for the anti-fungal released therefrom within from about 0.5 to about 2 hours after initiation of release, with the second dosage form of the at least three dosage forms producing a  $C_{max}$  for the anti-fungal released therefrom in no more than about four hours after initiation of release from the first dosage form. Thus,  $C_{max}$  for the second dosage form is achieved after  $C_{max}$  for the first dosage form and generally in no more than about 2 to about 3.5 hours after  $C_{max}$  is achieved from the first dosage form. In general, the  $C_{max}$  for such second dosage form is achieved no earlier than two hours after initiation of release from the first dosage form; however, it is possible within the scope of the invention to achieve  $C_{max}$  in a shorter period of time.

As hereinabove indicated, the anti-fungal product may contain at least three or at least four or more different dosage forms. For example, if the anti-fungal product includes a third dosage form, the anti-fungal released therefrom reaches a  $C_{max}$  at a time later than the  $C_{max}$  is achieved for the anti-fungal released from each of the first and second dosage forms. In a preferred embodiment, release of anti-fungal from the third dosage form is started after initiation of release of anti-fungal from both the first dosage form and the second dosage form. In one embodiment,  $C_{max}$  for anti-fungal release from the third dosage form is achieved within eight hours after initiation of release from the first dosage form.

In general, the first dosage form initiates release of anti-fungal at a time later than anti-fungal would be released from an immediate release dosage form. For example, the first dosage form would initiate release within 1 to four hours after administration of the product.

In another embodiment, the anti-fungal product contains at least four delayed release dosage forms, with each of the at least four dosage forms having different release profiles, whereby the anti-fungal release from each of the at least four different dosage forms achieves a  $C_{max}$  at a different time.

As hereinabove indicated, in a preferred embodiment, irrespective of whether the anti-fungal contains at least two or at least three or at least four different delayed release dosage forms each with a different release profile,  $C_{max}$  for all the anti-fungal released from the anti-fungal product is achieved in less than twelve hours after release is initiated from the first dosage form., and more generally is achieved in less than eleven hours.

In a preferred embodiment, the anti-fungal product is a once a day product, whereby after administration of the anti-fungal product, no further product is administered during the day; i.e., the preferred regimen is that the product is administered only once over a twenty-four hour period. Thus, in accordance with the present invention, there is a single administration of an anti-fungal product with the anti-fungal being released in a manner such that overall anti-fungal release is effected with different release profiles in a manner such that the overall  $C_{max}$  for the anti-fungal product is reached in less than twelve hours after first release of anti-fungal. The term single administration means that the total anti-fungal administered over a twenty-four hour period is administered at the same time, which can be a single tablet or capsule or two or more thereof, provided that they are administered at essentially the same time.

Applicant has found that a single dosage anti-fungal product comprised of at least three anti-fungal dosage forms each having a different release profile is an improvement over a single dosage anti-fungal product comprised of an anti-fungal dosage form having

a single release profile. Each of the dosage forms of anti-fungal in a pharmaceutically acceptable carrier may have one or more anti-fungals and each of the dosage forms may have the same anti-fungal or different anti-fungals.

It is to be understood that when it is disclosed herein that a dosage form initiates release after another dosage form, such terminology means that the dosage form is designed and is intended to produce such later initiated release. It is known in the art, however, notwithstanding such design and intent, some "leakage" of anti-fungal may occur. Such "leakage" is not "release" as used herein.

If at least four dosage forms are used, the fourth of the at least four dosage form may be a sustained release dosage form or a delayed release dosage form. If the fourth dosage form is a sustained release dosage form, even though  $C_{max}$  of the fourth dosage form of the at least four dosage forms is reached after the  $C_{max}$  of each of the other dosage forms is reached, anti-fungal release from such fourth dosage form may be initiated prior to or after release from the second or third dosage form.

The anti-fungal product of the present invention, as hereinabove described, may be formulated for administration by a variety of routes of administration. For example, the anti-fungal product may be formulated in a way that is suitable for topical administration; administration in the eye or the ear; rectal or vaginal administration; as nose drops; by inhalation; as an injectable; or for oral administration. In a preferred embodiment, the anti-fungal product is formulated in a manner such that it is suitable for oral administration.

For example, in formulating the anti-fungal product for topical administration, such as by application to the skin, the at least two different dosage forms, each of which contains an anti-fungal, may be formulated for topical administration by including such dosage forms in an oil-in-water emulsion, or a water-in-oil emulsion. In such a formulation, the immediate release dosage form is in the continuous phase, and the delayed release dosage form is in a discontinuous phase. The formulation may also be

produced in a manner for delivery of three dosage forms as hereinabove described. For example, there may be provided an oil-in-water-in-oil emulsion, with oil being a continuous phase that contains the immediate release component, water dispersed in the oil containing a first delayed release dosage form, and oil dispersed in the water containing a third delayed release dosage form.

It is also within the scope of the invention to provide an anti-fungal product in the form of a patch, which includes anti-fungal dosage forms having different release profiles, as hereinabove described.

In addition, the anti-fungal product may be formulated for use in the eye or ear or nose, for example, as a liquid emulsion. For example, the dosage form may be coated with a hydrophobic polymer whereby a dosage form is in the oil phase of the emulsion, and a dosage form may be coated with hydrophilic polymer, whereby a dosage form is in the water phase of the emulsion.

Furthermore, the anti-fungal product with at least three different dosage forms with different release profiles may be formulated for rectal or vaginal administration, as known in the art. This may take the form of a cream or emulsion, or other dissolvable dosage form similar to those used for topical administration.

As a further embodiment, the anti-fungal product may be formulated for use in inhalation therapy by coating the particles and micronizing the particles for inhalation.

In a preferred embodiment, the anti-fungal product is formulated in a manner suitable for oral administration. Thus, for example, for oral administration, each of the dosage forms may be used as a pellet or a particle, with a pellet or particle then being formed into a unitary pharmaceutical product, for example, in a capsule, or embedded in a tablet, or suspended in a liquid for oral administration.

Alternatively, in formulating an oral delivery system, each of the dosage forms of the product may be formulated as a tablet, with each of the tablets being put into a capsule to produce a unitary anti-fungal product. Thus, for example, anti-fungal products may include a first dosage form in the form of a tablet that is an immediate release tablet, and may also include two or more additional tablets, each of which provides for a delayed release of the anti-fungal, as hereinabove described, whereby the  $C_{max}$  of the anti-fungal released from each of the tablets is reached at different times, with the  $C_{max}$  of the total anti-fungal released from the anti-fungal product being achieved in less than twelve hours after anti-fungal is first released.

The formulation of an anti-fungal product including at least three dosage forms with different release profiles for different routes of administration is deemed to be within the skill of the art from the teachings herein. As known in the art, with respect to delayed release, the time of release can be controlled by the concentration of anti-fungals in the coating and/or the thickness of the coating.

In formulating an anti-fungal product in accordance with the invention, in one embodiment, the first dosage form of the product generally provides from about 20% to about 50% of the total dosage of anti-fungal to be delivered by the product, with such first dosage form generally providing at least 25% of the total dosage of the anti-fungal to be delivered by the product. In many cases, the first dosage form provides from about 20% to about 30% of the total dosage of anti-fungal to be delivered by the product; however, in some cases it may be desirable to have the first dosage form provide for about 45% to about 50% of the total dosage of anti-fungal to be delivered by the product.

The remaining dosage forms deliver the remainder of the anti-fungal. In one embodiment, each of the delayed release dosage forms after the first delayed release dosage form may provide about equal amounts of anti-fungal; however, they may also be formulated so as to provide different amounts.

In accordance with the present invention, each of the dosage forms contains the same anti-fungal; however, each of the dosage forms may contain more than one anti-fungal.

In one embodiment, where the composition contains three delayed release components, the first component provides from 20% to 35% (preferably 20% to 30%), by weight, of the total anti-fungal; where there are four delayed release components, the first delayed release component provides from 15% to 30%, by weight, of the total anti-fungal; and where there are five delayed release components, the first delayed release component provides from 10% to 25%, by weight, of the total anti-fungal.

With respect to the delayed release components, where there are three delayed release components, the second delayed release component provides from 30% to 60%, by weight, of the total anti-fungal provided by the second and third delayed release components with the third delayed release component providing the remainder of the anti-fungal.

Where there are four delayed release components, the second delayed release component provides 20% to 35% by weight of the total anti-fungal provided by the second, third and fourth delayed release components, the next in time delayed release component provides from 20% to 40%, by weight, of the anti-fungal provided by the second, third and fourth delayed release components and the last in time providing the remainder of the anti-fungal provided by the second, third and fourth delayed release components.

When there are five delayed release components, the second delayed release component provides from 15% to 30%, by weight, the next in time delayed release component provides from 15% to 30%, the next in time delayed release component provides from 20% to 35%, by weight, and the last in time delayed release component provides from 20% to 35%, by weight, in each case of the total anti-fungal provided by the second, third, fourth and fifth delayed release components.

**An Immediate Release Component**

The immediate release portion of this system can be a mixture of ingredients that breaks down quickly after administration to release the anti-fungal. This can take the form of either a discrete pellet or granule that is mixed in with, or compressed with, the other three components.

The materials to be added to the anti-fungals for the immediate release component can be, but are not limited to, microcrystalline cellulose, corn starch, pregelatinized starch, potato starch, rice starch, sodium carboxymethyl starch, hydroxypropylcellulose, hydroxypropylmethylcellulose, hydroxyethylcellulose, ethylcellulose, chitosan, hydroxychitosan, hydroxymethylatedchitosan, cross-linked chitosan, cross-linked hydroxymethyl chitosan, maltodextrin, mannitol, sorbitol, dextrose, maltose, fructose, glucose, levulose, sucrose, polyvinylpyrrolidone (PVP), acrylic acid derivatives (Carbopol, Eudragit, etc.), polyethylene glycols, such a low molecular weight PEGs (PEG2000-10000) and high molecular weight PEGs (Polyox) with molecular weights above 20,000 daltons.

It may be useful to have these materials present in the range of 1.0 to 60% (W/W).

In addition, it may be useful to have other ingredients in this system to aid in the dissolution of the drug, or the breakdown of the component after ingestion or administration. These ingredients can be surfactants, such as sodium lauryl sulfate, sodium monoglycerate, sorbitan monooleate, sorbitan monooleate, polyoxyethylene sorbitan monooleate, glyceryl monostearate, glyceryl monooleate, glyceryl monobutyrate, one of the non-ionic surfactants such as the Pluronic line of surfactants, or any other material with surface active properties, or any combination of the above.

These materials may be present in the rate of 0.05-15% (W/W).

**The non-pH Sensitive Delayed Release Component**

The components in this composition are the same immediate release unit, but with additional polymers integrated into the composition, or as coatings over the pellet or granule.

Materials that can be used to obtain a delay in release suitable for this component of the invention can be, but are not limited to, polyethylene glycol (PEG) with molecular weight above 4,000 daltons (Carbowax, Polyox), waxes such as white wax or bees wax, paraffin, acrylic acid derivatives (Eudragit), propylene glycol, and ethylcellulose.

Typically these materials can be present in the range of 0.5-25% (W/W) of this component.

#### **The pH Sensitive (Enteric) Release Component**

The components in this composition are the same as the immediate release component, but with additional polymers integrated into the composition, or as coatings over the pellet or granule.

The kind of materials useful for this purpose can be, but are not limited to, cellulose acetate pthalate, Eudragit L, and other pthalate salts of cellulose derivatives.

These materials can be present in concentrations from 4-20% (W/W).

#### **Sustained Release Component**

The components in this composition are the same as the immediate release component, but with additional polymers integrated into the composition, or as coatings over the pellet or granule.

The kind of materials useful for this purpose can be, but are not limited to, ethylcellulose, hydroxypropylmethylcellulose, hydroxypropylcellulose, hydroxyethylcellulose, carboxymethylcellulose, methylcellulose, nitrocellulose, Eudragit R, and Eudragit RL, Carbopol, or polyethylene glycols with molecular weights in excess of 8,000 daltons.

These materials can be present in concentrations from 4-20% (W/W).

As hereinabove indicated, the units comprising the anti-fungal composition of the present invention can be in the form of discrete pellets or particles contained in the capsule, or particles embedded in a tablet or suspended in a liquid suspension.

The anti-fungal composition of the present invention may be administered, for example, by any of the following routes of administration: sublingual, transmucosal, transdermal, parenteral, etc., and preferably is administered orally. The composition includes a therapeutically effective amount of the anti-fungal, which amount will vary with the anti-fungal to be used, the disease or infection to be treated, and the number of times that the composition is to be delivered in a day. The composition is administered to a host in an amount effective for treating a bacterial infection.

The following are representative examples of some antifungals that can be employed in the composition of the invention: amphotericin B, flucytosine, fluconazole, griseofulvin, miconazole nitrate, terbinafine hydrochloride, ketoconazole, itraconazole, undecylenic acid and chloroxylenol, ciclopirox, clotrimazole, butenafine hydrochloride, nystatin, naftifine hydrochloride, oxiconazole nitrate, selenium sulfide, econazole nitrate, terconazole, butoconazole nitrate, carbol-fuchsin, clioquinol, methylrosaniline chloride, sodium thiosulfate, sulconazole nitrate, terbinafine hydrochloride, tioconazole, tolnaftate, undecylenic acid and undecylenate salts (calcium undecylenate, copper undecylenate, zinc undecylenate)

The invention will be further described with respect to the following examples; however, the scope of the invention is not limited thereby. All percentages in this specification, unless otherwise specified, are by weight.

### **non-pH Sensitive Delayed Release Component**

Formulate the composition by mixing the ingredients in a suitable pharmaceutical mixer or granulator such as a planetary mixer, high-shear granulator, fluid bed granulator, or extruder, in the presence of water or other solvent, or in a hot melt process. If water or other solvent was used, dry the blend in a suitable pharmaceutical drier, such as a vacuum oven or forced-air oven. Allow the product to cool, the product may be sieved or granulated, and compressed using a suitable tablet press, such as a rotary tablet press.

	<u>Ingredient</u>	<u>Conc. (% W/W)</u>
Example 1:	Fluorouracil	65% (W/W)
	Microcrystalline cellulose	20
	Polyox	7.5
	Croscarmellose sodium	7.5
Example 2:	Fluorouracil	55% (W/W)
	Microcrystalline cellulose	25
	Polyox	10
	Glyceryl monooleate	10
Example 3:	Fluorouracil	75% (W/W)
	Polyox	10
	Hydroxypropylcellulose	5
	Croscarmellose sodium	10
Example 4:	Dexamethasone	65% (W/W)
	Microcrystalline cellulose	20
	Polyox	7.5
	Croscarmellose sodium	7.5
Example 5:	Dexamethasone	55% (W/W)
	Microcrystalline cellulose	25
	Polyox	10
	Glyceryl monooleate	10

Example 6:	Dexamethasone	75% (W/W)
	Polyox	10
	Hydroxypropylcellulose	5
	Croscarmellose sodium	10
Example 7:	Valrubicin	65% (W/W)
	Microcrystalline cellulose	20
	Polyox	7.5
	Croscarmellose sodium	7.5
Example 8:	Valrubicin	55% (W/W)
	Microcrystalline cellulose	25
	Polyox	10
	Glyceryl monooleate	10
Example 9:	Valrubicin	75% (W/W)
	Polyox	10
	Hydroxypropylcellulose	5
	Croscarmellose sodium	10
Example 10:	Tretinoin	65% (W/W)
	Microcrystalline cellulose	20
	Polyox	7.5
	Croscarmellose sodium	7.5
Example 11:	Tretinoin	55% (W/W)
	Microcrystalline cellulose	25
	Polyox	10
	Glyceryl monooleate	10
Example 12:	Tretinoin	75% (W/W)
	Polyox	10
	Hydroxypropylcellulose	5
	Croscarmellose sodium	10

### Enteric Release Component

Formulate the ingredients by mixing the ingredients in a suitable pharmaceutical mixer or granulator such as a planetary mixer, high-shear granulator, fluid bed granulator, or extruder, in the presence of water or other solvent, or in a hot melt process. If water or other solvent was used, dry the blend in a suitable pharmaceutical drier, such as a vacuum oven or forced-air oven. Allow the product to cool, the product may be sieved or granulated, and compressed using a suitable tablet press, such as a rotary tablet press.

	<u>Ingredient</u>	<u>Conc. (% W/W)</u>
Example 13:	Fluconazole	65% (W/W)
	Microcrystalline cellulose	20
	Cellulose Acetate Pthalate	15
Example 14:	Fluconazole	55% (W/W)
	Microcrystalline cellulose	25
	Cellulose Acetate Pthalate	10
	Hydroxypropylmethylcellulose	10
Example 15:	Fluconazole	65% (W/W)
	Polyox	20
	Hydroxypropylcellulose pthalate	10
	Eudragit L30D	5
Example 16:	Fluconazole	40% (W/W)
	Microcrystalline Cellulose	40
	Cellulose Acetate Pthalate	10
Example 17:	Ketoconazole	70% (W/W)
	Hydroxypropylcellulose pthalate	15
	Croscarmellose sodium	10
Example 18:	Ketoconazole	75% (W/W)
	Polyethylene glycol 2000	10
	Eudragit L 30D	15

## Example 19:

Ketoconazole	40% (W/W)
Lactose	50
Eudragit L 30D	10

## Example 20:

Griseofulvin	65% (W/W)
Microcrystalline Cellulose	20
Eudragit L 30D	10

## Example 21:

Griseofulvin	75% (W/W)
Microcrystalline Cellulose	15
Hydroxypropylcellulose pthalate	10

## Example 22:

Griseofulvin	80% (W/W)
Lactose	10
Eudragit L 30D	10

## Example 23:

Griseofulvin	70% (W/W)
Polyethylene glycol 4000	20
Cellulose acetate pthalate	10

## Example 24:

Terbinafine HCl	60% (W/W)
Polyethylene glycol 2000	10
Lactose	20
Eudragit L 30D	10

## Example 25:

Terbinafine HCl	70% (W/W)
Microcrystalline cellulose	20
Cellulose acetate pthalate	10

### Sustained Release Component

Formulate the composition by mixing the ingredients in a suitable pharmaceutical mixer or granulator such as a planetary mixer, high-shear granulator, fluid bed granulator, or extruder, in the presence of water or other solvent, or in a hot melt process. If water or other solvent was used, dry the blend in a suitable pharmaceutical drier, such as a vacuum oven or forced-air oven. Allow the product to cool, the product may be sieved or granulated, and compressed using a suitable tablet press, such as a rotary tablet press.

	<u>Ingredient</u>	<u>Conc. (% W/W)</u>
Example 26:	Fluconazole	65% (W/W)
	Ethylcellulose	20
	Polyox	10
	Hydroxypropylmethylcellulose	5
Example 27:	Fluconazole	55% (W/W)
	Lactose	25
	Polyox	10
	Glyceryl monooleate	10
Example 28:	Fluconazole	70% (W/W)
	Polyox	20
	Hydroxypropylcellulose	10
Example 29:	Ketoconazole	75% (W/W)
	Lactose	15
	Hydroxypropylcellulose	5
	Ethylcellulose	5
Example 30:	Ketoconazole	75% (W/W)
	Polyethylene glycol 4000	10
	Lactose	10
	Eudragit RL 30D	5

## Example 31:

Ketoconazole	80% (W/W)
Polyethylene glycol 8000	10
Hydroxypropylmethylcellulose	5
Eudragit RS 30D	5

## Example 32:

Griseofulvin	75% (W/W)
Hydroxyethylcellulose	10
Polyethylene glycol 4000	10
Hydroxypropylcellulose	5

## Example 33:

Griseofulvin	75% (W/W)
Lactose	10
Povidone (PVP)	10
Polyethylene glycol 2000	5

## Example 34:

Terbinafine HCl	75% (W/W)
Polyethylene glycol 4000	10
Povidone (PVP)	10
Hydroxypropylcellulose	5

## Example 35:

Terbinafine HCl	75% (W/W)
Lactose	15
Polyethylene glycol 4000	5
Polyvinylpyrrolidone	5

## Example 36:

Ketoconazole	40% (W/W)
Eudragit S100	50
Triethyl Citrate	10

## Example 37:

Ketoconazole	50% (W/W)
Sureteric	50

## Example 38:

Ketoconazole	50% (W/W)
Eudragit S100	45
Triethyl Citrate	5

**All delayed release three pulses**

**Example 39**

**Anti-fungal Pellet Formulation and Preparation Procedure**

**Pellet Formulations**

The composition of the Anti-fungal pellets provided in Table 1.

**Table 1 Composition of Anti-fungal Pellets**

Component	Percentage (%)
Anti-fungal drug	92
Avicel PH 101	6.0
Polyoxyl 35 Castor Oil*	1.0
Hydroxypropyl methylcellulose, NF*	1.0
Purified Water	**
Total	100

\*Hydroxypropyl methylcellulose and Cremaphor EL

were added as a 2.9% w/w aqueous solution during  
wet massing.

\*\*Removed during processing

**Preparation Procedure for Anti-fungal Pellets**

- Blend Anti-fungal and Avicel® PH 101 using a high shear mixer.
- Add the hydroxypropyl methylcellulose and Polyoxyl 35 Castor Oil binder solution slowly into the powder blend under continuous mixing.

- Extrude the wet mass using an LCI Bench Top Granulator. The diameter of the screen of the Bench Top Granulator is 0.8 mm.
- Spheronize the extrudate using a QJ-230 Spheronizer using a small cross section plate.
- Dry the spheronized pellets at 60°C using a fluid bed dryer until the exhaust temperature reaches 40°C.
- Pellets between 20 and 40 Mesh were collected for further processing.

## Anti-fungal Pulse One Pellet Formulation and Preparation Procedure

### Preparation of an AQOAT AS-LF Aqueous Coating Dispersion

#### Dispersion Formulation

The composition of the aqueous AQOAT AS-LF aqueous coating dispersion applied to the Anti-fungal pellets is provided below in Table 2.

**Table 2 AQOAT AS-LF Aqueous Coating Dispersion**

Component	Percentage (%)
AQOAT AS-LF	7.0
Triethyl Citrate	2.0
Talc	2.1
Sodium lauryl sulfate	0.2
Purified Water*	88.7
Solid Content	11.3
Polymer Content	7.0

\*Removed during processing

#### Preparation Procedure for an AQOAT AS-LF Aqueous Dispersion

- Add triethyl citrate (TEC) to the purified water with stirring.
- Add the sodium lauryl sulfate (SLS) to the TEC dispersion with stirring and completely until completely dissolved.
- Add the AQOAT to the TEC/SLS dispersion and stir for at least 30 minutes.

- Add the talc to the AQOAT dispersion and until completely mixed and for at least 30 minutes.
- Screen the dispersion through a No. 60 mesh sieve prior to coating.
- Continue to stir the dispersion until the coating process is complete.

Coating Conditions for the Application of AQOAT AS-LF Aqueous Coating Dispersion

The following coating parameters were used for coating of the AQOAT AS-LF film coating dispersion.

Coating Equipment	STREA 1™ Table Top Laboratory Fluid Bed Coater
Spray nozzle diameter	1.0 mm
Material Charge	300 gram
Inlet Air Temperature	48 °C
Outlet Air Temperature	27 °C
Atomization Air Pressure	1.6 Bar
Pump Rate	3-4 gram per minute

Coat Anti-fungal pellets with AQOAT AS-LF film coating dispersion such that you apply 30% coat weight gain to the pellets.

## Anti-fungal Pulse Two Pellet Formulation and Preparation Procedure

### Preparation of an AQOAT AS-HF Aqueous Coating Dispersion

#### Dispersion Formulation

The composition of the aqueous AQOAT AS-HF aqueous coating dispersion applied to the Anti-fungal pellets is provided below in Table 3.

**Table 3 AQOAT AS-HF Aqueous Coating Dispersion**

Component	Percentage (%)
AQOAT AS-HF	7.0
Triethyl Citrate	2.0
Talc	2.1
Sodium lauryl sulfate	0.2
Purified Water*	88.7
Solid Content	11.3
Polymer Content	7.0

\*Removed during processing

#### Preparation Procedure for an AQOAT AS-HF Aqueous Dispersion

- Add triethyl citrate (TEC) to the purified water with stirring.
- Add the sodium lauryl sulfate (SLS) to the TEC dispersion with stirring and completely until completely dissolved.
- Add the AQOAT to the TEC/SLS dispersion and stir for at least 30 minutes.

- Add the talc to the AQOAT dispersion and until completely mixed and for at least 30 minutes.
- Screen the dispersion through a No. 60 mesh sieve prior to coating.
- Continue to stir the dispersion until the coating process is complete.

Coating Conditions for the Application of AQOAT AS-HF Aqueous Coating Dispersion

The following coating parameters were used for coating of the AQOAT AS-HF film coating dispersion.

Coating Equipment	STREA 1™ Table Top Laboratory Fluid Bed Coater
Spray nozzle diameter	1.0 mm
Material Charge	300 gram
Inlet Air Temperature	48 °C
Outlet Air Temperature	27 °C
Atomization Air Pressure	1.6 Bar
Pump Rate	3-4 gram per minute

Coat Anti-fungal pellets with AQOAT AS-HF film coating dispersion such that you apply 30% coat weight gain to the pellets.

## Anti-fungal Pulse Three Pellet Formulation and Preparation Procedure

### Preparation of an Eudragit® FS 30D Aqueous Coating Dispersion

#### Dispersion Formulation

The composition of the aqueous Eudragit® FS 30D dispersion applied to the Anti-fungal pellets is provided below in Table 4.

**Table 4 Eudragit® FS 30D Aqueous Coating Dispersion**

Component	Percentage (%)
Eudragit® FS 30D	54.8
Triethyl Citrate	0.9
Talc	3.3
Purified Water*	41.0
Solid Content	20.6
Polymer Content	16.4

\*Removed during processing

### Preparation Procedure for an Eudragit® FS 30D Aqueous Dispersion

- Disperse triethyl citrate (TEC) in the purified water.
- Add the talc in the triethyl citrate dispersion.
- Homogenize the dispersion using a homogenizer.
- Add slowly the Eudragit® FS 30D dispersion to the talc/TEC dispersion with stirring.

Continue to stir the coating dispersion until the coating process is complete.

Coating Conditions for the Application of Eudragit FS30D Aqueous Coating Dispersion

The following coating parameters were used for coating with each of the Eudragit® FS 30 D aqueous film coating.

Coating Equipment	STREA 1™ Table Top Laboratory Fluid Bed Coater
Spray nozzle diameter	1.2 mm
Material Charge	300 gram
Inlet Air Temperature	38 °C
Outlet Air Temperature	22 °C
Atomization Air Pressure	1.6 Bar
Pump Rate	6 gram per minute

Coat pellets with Eudragit FS 30D coating dispersion such that you apply 30% coat weight gain to the pellets.

**Anti-fungal Tablets**Tableting of the Anti-fungal Pellets**Table 5 Composition of Anti-fungal Tablets**

Component	Percentage (%)
Silicified microcrystalline cellulose	21.6
Lactose monohydrate	13.0
Povidone	5.0
Pulse One Pellets	18.3
Pulse Two Pellets	18.3
Pulse Three Pellets	18.3

Croscarmellose sodium	5.0
Magnesium stearate	0.5
Total	100

- Blend the silicified microcrystalline cellulose, lactose monohydrate, povidone, colloidal silicon dioxide and Anti-fungal coated pellets for 15 minutes in a tumble blender.
- Add the magnesium stearate to the blender, and blend for 5 minutes.
- Compress the blend on a rotary tablet press.
- The fill weight should be adjusted to achieve the desired dose.

#### **Encapsulation of the Anti-fungal Pellets**

Pellets are filled into hard gelatin capsules at a ratio of 33.4%: 33.3%: 33.3%: Pulse One, Pulse Two, and Pulse Three Pellets respectively. The capsule is filled with the three different pellets to achieve the desired dose.

The present invention is particularly advantageous in that there is provided an anti-fungal product which provides an improvement over twice a day administration of the anti-fungal and an improvement over a once a day administration of the anti-fungal.

Numerous modification and variations of the present invention are possible in light of the above teachings and therefore, within the scope of the appended claims the invention may be practiced otherwise than as particularly described.

#### **All delayed release four pulses**

##### **Example 40**

##### **Anti-fungal Pellet Formulation and Preparation Procedure**

Pellet Formulations

The composition of the Anti-fungal pellets provided in Table 6.

**Table 6 Composition of Anti-fungal Pellets**

Component	Percentage (%)
Anti-fungal drug	92
Avicel PH 101	6.0
Polyoxyl 35 Castor Oil*	1.0
Hydroxypropyl methylcellulose, NF*	1.0
Purified Water	**
Total	100

\*Hydroxypropyl methylcellulose and Cremaphor EL

were added as a 2.9% w/w aqueous solution during

wet massing.

\*\*Removed during processing

Preparation Procedure for Anti-fungal Pellets

- Blend Anti-fungal and Avicel® PH 101 using a high shear mixer.
- Add the hydroxypropyl methylcellulose and Polyoxyl 35 Castor Oil binder solution slowly into the powder blend under continuous mixing.
- Extrude the wet mass using an LCI Bench Top Granulator. The diameter of the screen of the Bench Top Granulator is 0.8 mm.
- Spheronize the extrudate using a QJ-230 Spheronizer using a small cross section plate.

- Dry the spheronized pellets at 60°C using a fluid bed dryer until the exhaust temperature reaches 40°C.
- Pellets between 20 and 40 Mesh were collected for further processing.

## Anti-fungal Pulse One Pellet Formulation and Preparation Procedure

### Preparation of an AQOAT AS-LF Aqueous Coating Dispersion

#### Dispersion Formulation

The composition of the aqueous AQOAT AS-LF aqueous coating dispersion applied to the Anti-fungal pellets is provided below in Table 7.

**Table 7 AQOAT AS-LF Aqueous Coating Dispersion**

Component	Percentage (%)
AQOAT AS-LF	7.0
Triethyl Citrate	2.0
Talc	2.1
Sodium lauryl sulfate	0.2
Purified Water*	88.7
Solid Content	11.3
Polymer Content	7.0

\*Removed during processing

#### Preparation Procedure for an AQOAT AS-LF Aqueous Dispersion

- Add triethyl citrate (TEC) to the purified water with stirring.
- Add the sodium lauryl sulfate (SLS) to the TEC dispersion with stirring and completely until completely dissolved.
- Add the AQOAT to the TEC/SLS dispersion and stir for at least 30 minutes.

- Add the talc to the AQOAT dispersion and until completely mixed and for at least 30 minutes.
- Screen the dispersion through a No. 60 mesh sieve prior to coating.
- Continue to stir the dispersion until the coating process is complete.

Coating Conditions for the Application of AQOAT AS-LF Aqueous Coating Dispersion

The following coating parameters were used for coating of the AQOAT AS-LF film coating dispersion.

Coating Equipment	STREA 1™ Table Top Laboratory Fluid Bed Coater
Spray nozzle diameter	1.0 mm
Material Charge	300 gram
Inlet Air Temperature	48 °C
Outlet Air Temperature	27 °C
Atomization Air Pressure	1.6 Bar
Pump Rate	3-4 gram per minute

Coat Anti-fungal pellets with AQOAT AS-LF film coating dispersion such that you apply 30% coat weight gain to the pellets.

## Anti-fungal Pulse Two Pellet Formulation and Preparation Procedure

### Preparation of an Eudragit® L 30 D-55 Aqueous Coating Dispersion

#### Dispersion Formulation

The composition of the aqueous Eudragit L30D-55 aqueous coating dispersion applied to the Anti-fungal pellets is provided below in Table 8.

**Table 8 Eudragit® L 30 D-55 Aqueous Coating Dispersion**

Component	Percentage (%)
Eudragit® L 30D-55	44.4
Triethyl Citrate	1.3
Talc	6.7
Purified Water*	47.6
Solid Content	21.3
Polymer Content	13.3

\*Removed during processing

#### Preparation Procedure for an Eudragit® L 30D-55 Aqueous Dispersion

- Disperse triethyl citrate (TEC) in the purified water.
- Add the talc into the triethyl citrate dispersion.
- Homogenize the dispersion using a homogenizer.
- Add the TEC/talc dispersion to Eudragit L30D-55 latex dispersion and stir for at least 30 minutes.
- Screen the dispersion through a No. 60 mesh sieve prior to coating.

- Continue to stir the dispersion until the coating process is complete.

Coating Conditions for the Application of Eudragit L30D-55 Aqueous Coating Dispersion

The following coating parameters were used for coating of the Eudragit® L 30 D-55 film coating dispersion.

Coating Equipment	STREA 1™ Table Top Laboratory Fluid Bed Coater
Spray nozzle diameter	1.0 mm
Material Charge	300 gram
Inlet Air Temperature	45 °C
Outlet Air Temperature	32 to 35 °C
Atomization Air Pressure	1.6 Bar
Pump Rate	3-4 gram per minute

Coat Anti-fungal pellets with Eudragit L30 D-55 film coating dispersion such that you apply 30% coat weight gain to the pellets.

**Anti-fungal Pulse Three Pellets Formulation and Preparation Procedure**Preparation of an AQOAT AS-HF Aqueous Coating DispersionDispersion Formulation

The composition of the aqueous AQOAT AS-HF aqueous coating dispersion applied to the Anti-fungal pellets is provided below in Table 9.

**Table 9 AQOAT AS-HF Aqueous Coating Dispersion**

Component	Percentage (%)
AQOAT AS-HF	7.0
Triethyl Citrate	2.0
Talc	2.1
Sodium lauryl sulfate	0.2
Purified Water*	88.7
Solid Content	11.3
Polymer Content	7.0

\*Removed during processing

Preparation Procedure for an AQOAT AS-HF Aqueous Dispersion

- Add triethyl citrate (TEC) to the purified water with stirring.
- Add the sodium lauryl sulfate (SLS) to the TEC dispersion with stirring and completely until completely dissolved.
- Add the AQOAT to the TEC/SLS dispersion and stir for at least 30 minutes.

- Add the talc to the AQOAT dispersion and until completely mixed and for at least 30 minutes.
- Screen the dispersion through a No. 60 mesh sieve prior to coating.
- Continue to stir the dispersion until the coating process is complete.

Coating Conditions for the Application of AQOAT AS-HF Aqueous Coating Dispersion

The following coating parameters were used for coating of the AQOAT AS-HF film coating dispersion.

Coating Equipment	STREA 1™ Table Top Laboratory Fluid Bed Coater
Spray nozzle diameter	1.0 mm
Material Charge	300 gram
Inlet Air Temperature	48 °C
Outlet Air Temperature	27 °C
Atomization Air Pressure	1.6 Bar
Pump Rate	3-4 gram per minute

Coat Anti-fungal pellets with AQOAT AS-HF film coating dispersion such that you apply 30% coat weight gain to the pellets.

## Anti-fungal Pulse Four Pellet Formulation and Preparation Procedure

### Preparation of an Eudragit® FS 30D Aqueous Coating Dispersion

#### Dispersion Formulation

The composition of the aqueous Eudragit® FS 30D dispersion applied to the Anti-fungal pellets is provided below in Table 10.

**Table 10 Eudragit® FS 30D Aqueous Coating Dispersion**

Component	Percentage (%)
Eudragit® FS 30D	54.8
Triethyl Citrate	0.9
Talc	3.3
Purified Water*	41.0
Solid Content	20.6
Polymer Content	16.4

\*Removed during processing

### Preparation Procedure for an Eudragit® FS 30D Aqueous Dispersion

- Disperse triethyl citrate (TEC) in the purified water.
- Add the talc in the triethyl citrate dispersion.
- Homogenize the dispersion using a homogenizer.
- Add slowly the Eudragit® FS 30D dispersion to the talc/TEC dispersion with stirring.

Continue to stir the coating dispersion until the coating process is complete.

Coating Conditions for the Application of Eudragit FS30D Aqueous Coating Dispersion

The following coating parameters were used for coating with each of the Eudragit® FS 30 D aqueous film coating.

Coating Equipment	STREA 1™ Table Top Laboratory Fluid Bed Coater
Spray nozzle diameter	1.2 mm
Material Charge	300 gram
Inlet Air Temperature	38 °C
Outlet Air Temperature	22 °C
Atomization Air Pressure	1.6 Bar
Pump Rate	6 gram per minute

Coat pellets with Eudragit FS 30D coating dispersion dispersion such that you apply 30% coat weight gain to the pellets.

**Anti-fungal Tablets**Tableting of the Anti-fungal Pellets**Table 11 Composition of Anti-fungal Tablets**

Component	Percentage (%)
Silicified microcrystalline cellulose	21.5
Lactose monohydrate	13.0
Povidone	5.0
Pulse One Pellets	13.75
Pulse Two Pellets	13.75
Pulse Three Pellets	13.75

Pulse Four Pellets	13.75
Croscarmellose sodium	5.0
Magnesium stearate	0.5
Total	100

- Blend the silicified microcrystalline cellulose, lactose monohydrate, povidone, colloidal silicon dioxide and Anti-fungal coated pellets for 15 minutes in a tumble blender.
- Add the magnesium stearate to the blender, and blend for 5 minutes.
- Compress the blend on a rotary tablet press.
- The fill weight should be adjusted to achieve the desired dose.

#### **Encapsulation of the Anti-fungal Pellets**

Pellets are filled into hard gelatin capsules at a ratio of 25%: 25%: 25%: 25% Pulse One, Pulse Two, Pulse Three and Pulse Four Pellets respectively. The capsule is filled with the four different pellets to achieve the desired dose.

The present invention is particularly advantageous in that there is provided an anti-fungal product which provides an improvement over twice a day administration of the anti-fungal and an improvement over a once a day administration of the anti-fungal.

Numerous modification and variations of the present invention are possible in light of the above teachings and therefore, within the scope of the appended claims the invention may be practiced otherwise than as particularly described.

The present invention is particularly advantageous in that there is provided an anti-fungal product which provides an improvement over twice a day administration of the anti-fungal and an improvement over a once a day administration of the anti-fungal.

Numerous modification and variations of the present invention are possible in light of the above teachings and therefore, within the scope of the appended claims the invention may be practiced otherwise than as particularly described.

## WHAT IS CLAIMED IS:

1. An anti-fungal product comprising: a first anti-fungal dosage form, a second anti-fungal dosage form, and a third anti-fungal dosage form, each of said first, second and third anti-fungal dosage forms comprising an anti-fungal and a pharmaceutically acceptable carrier, said three dosage forms having different release profiles, said anti-fungal product reaching a  $C_{max}$  in less than about twelve hours after initial release of anti-fungal and each being a delayed release dosage form.
2. The product of Claim 1 wherein the first dosage form is an immediate release dosage form.
3. The product of Claim 2 wherein the  $C_{max}$  for the product is reached no earlier than four hours after initial release of anti-fungal.
4. The product of Claim 2 wherein the first dosage form contains at least 20% and no more than 50% of the total dosage of anti-fungal.
5. The product of Claim 4 wherein the product is an oral dosage form.
6. The product of Claim 5 wherein the anti-fungal released from the second dosage form reaches a  $C_{max}$  in the serum after  $C_{max}$  is reached in the serum for anti-fungal released from the first dosage form.
7. The product of Claim 6 wherein the anti-fungal released from the third dosage form reaches a  $C_{max}$  in the serum after the anti-fungal released from the second dosage form reaches a  $C_{max}$  in the serum.
8. The anti-fungal product of Claim 1 wherein said anti-fungal product includes a total dosage of anti-fungal that is effective for a twenty four hour period.
9. The product of Claim 1 and further comprising a fourth anti-fungal dosage form comprising an anti-fungal and a pharmaceutically acceptable carrier, wherein anti-fungal released from the fourth dosage form reaches a  $C_{max}$  in the serum after  $C_{max}$  is achieved in the serum for anti-fungal released from each of the first, second and third dosage forms.
10. A process for treating a fungal infection in a host comprising:  
administering to a host the anti-fungal product of Claim 1.
11. A process for treating a fungal infection in a host comprising:  
administering to a host the anti-fungal product of Claim 2.

12. A process for treating a fungal infection in a host comprising:  
administering to a host the anti-fungal product of Claim 3.
13. A process for treating a fungal infection in a host comprising:  
administering to a host the anti-fungal product of Claim 4.
14. A process for treating a fungal infection in a host comprising:  
administering to a host the anti-fungal product of Claim 5.
15. A process for treating a fungal infection in a host comprising:  
administering to a host the anti-fungal product of Claim 6.
16. A process for treating a fungal infection in a host comprising:  
administering to a host the anti-fungal product of Claim 7.
17. A process for treating a fungal infection in a host comprising:  
administering to a host the anti-fungal product of Claim 8.
18. A process for treating a fungal infection in a host comprising:  
administering to a host the anti-fungal product of Claim 9.
19. An anti-fungal product comprising: a first anti-fungal dosage form, a second anti-fungal dosage form, and a third anti-fungal dosage form, each of said first, second and third anti-fungal dosage forms comprising an anti-fungal and a pharmaceutically acceptable carrier, said three dosage forms having different release profiles, said anti-fungal product reaching a  $C_{max}$  in less than about twelve hours after initial release of anti-fungal from the product, said first, second and third dosage forms, each being a delayed release dosage form, wherein the anti-fungal released from the first dosage form reaches a  $C_{max}$  in serum in from 0.5 to 2 hours after initial release of anti-fungal from the product, wherein the anti-fungal released from the second dosage form reaches a  $C_{max}$  in serum in no more than about 4 hours after initial release of anti-fungal from the product and after  $C_{max}$  is reached for anti-fungal from the first dosage form and the anti-fungal released from the third dosage form reaches a  $C_{max}$  in serum after the  $C_{max}$  is reached for the anti-fungal released from the second dosage form.
20. The product of claim 19 wherein the second dosage form initiates release of the anti-fungal at least one hour after the first dosage form.
21. The product of claim 20 wherein the  $C_{max}$  for the second dosage form is reached no earlier than two hours after initial release of anti-fungal from the product.

22. The product of claim 21 wherein the first dosage form contains from about 20% to about 50%, by weight, of the total anti-fungal of the product, wherein the second dosage form contains from 30% to 60%, by weight, of the anti-fungal that is contained in the second and third dosage forms.

23. The product of claim 22 wherein the first dosage form contains from 15% to 30%, by weight, of the total anti-fungal present in the product.

24. The product of Claim 22 wherein the product includes a fourth delayed release anti-fungal dosage form having a different release profile from the first, second and third dosage forms and  $C_{max}$  for the fourth dosage form is reached after  $C_{max}$  for each of the first, second and third dosage forms.

25. The product of claim 24 wherein the second dosage form contains from 20% to 35%, by weight, of the total anti-fungal present in the second, third and fourth dosage forms, the third dosage form contains from 20% to 40%, by weight, of the total anti-fungal present in the second, third and fourth dosage forms, with the remainder being present in the fourth dosage form.

26. The product of claim 19 wherein  $C_{max}$  for the product is reached no earlier than four hours after initial release of anti-fungal.

27. The product of claim 26 wherein  $C_{max}$  in serum for the second dosage form is reached within 8 hours after initial release of anti-fungal from the product.

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/24438

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : A01N 25/34; A61K 9/48  
 US CL : 424/408,451

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
 U.S. : 424/408,451

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
 BRS

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,672,359 A (DIGENIS et al.) 30 September 1997 (30.09.1997), column 5, lines 1-12, 24-30, 61-65; column 8, lines 1-10; column 9, lines 1-11, 54-62; column 13, lines 1-25; column 16, claim 16.	1-27

<input type="checkbox"/>	Further documents are listed in the continuation of Box C.	<input type="checkbox"/>	See patent family annex.
*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier application or patent published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
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Name and mailing address of the ISA/US  
 Mail Stop PCT, Attn: ISA/US  
 Commissioner for Patents  
 P.O. Box 1450  
 Alexandria, Virginia 22313-1450  
 Facsimile No. (703)305-3230

Authorized officer  
  
 Robert M. Joynes  
 Telephone No. (703) 308-1235